

# Comparative Measurements of Tire/Pavement Noise in Europe and California/Arizona

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Acoustics • Air Quality

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# NITE Project Concept & Objectives

## Concept

- Provide the first definitive data base comparing European pavement noise to that in the US
- Benchmark “quiet pavement” – US vs. Europe
- Compliment to the AASHTO/FHWA Scan

## Objectives

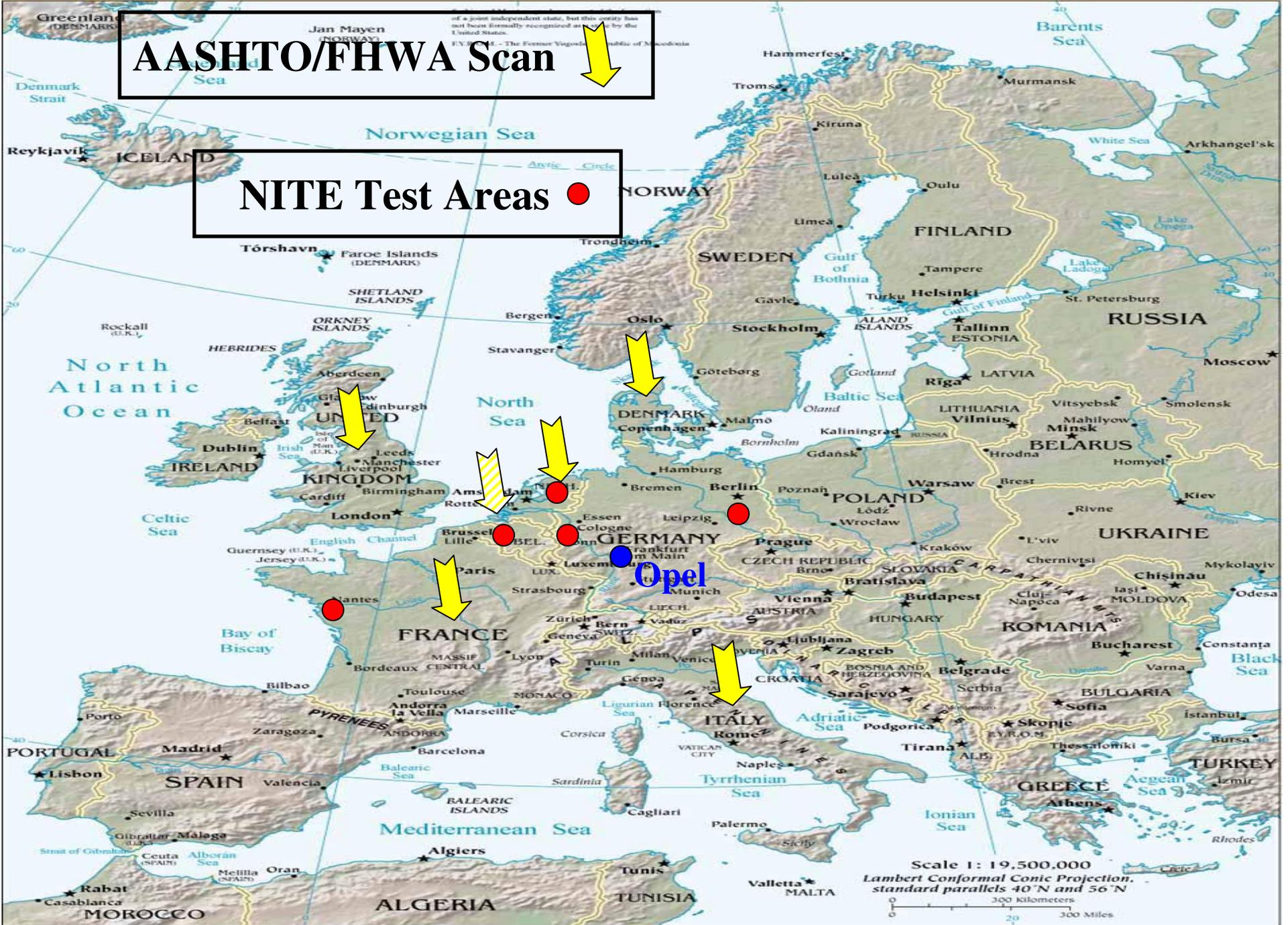
- Measure the quietest pavement of all types
- Measure the range of pavements in use
- Relate Caltrans SI and European CPX measurements

# EUROPE

AASHTO/FHWA Scan



NITE Test Areas



# NITE Project - Measurements

- 3 weeks in duration, completed early October 2004
- Test speeds
  - 97 km/h (60 mph) primary speed - 62 pavements
  - 56 km/h (35 mph) secondary speed - 33 pavements
- Test tires
  - Caltrans standard tire – Goodyear Aquatred 3
    - All test surfaces
    - 60 and 35 mph
  - Alternate tire – Uniroyal Tiger Paw AWP
    - Test tracks + 1 in-use motorway in the Netherlands
    - 60 mph only

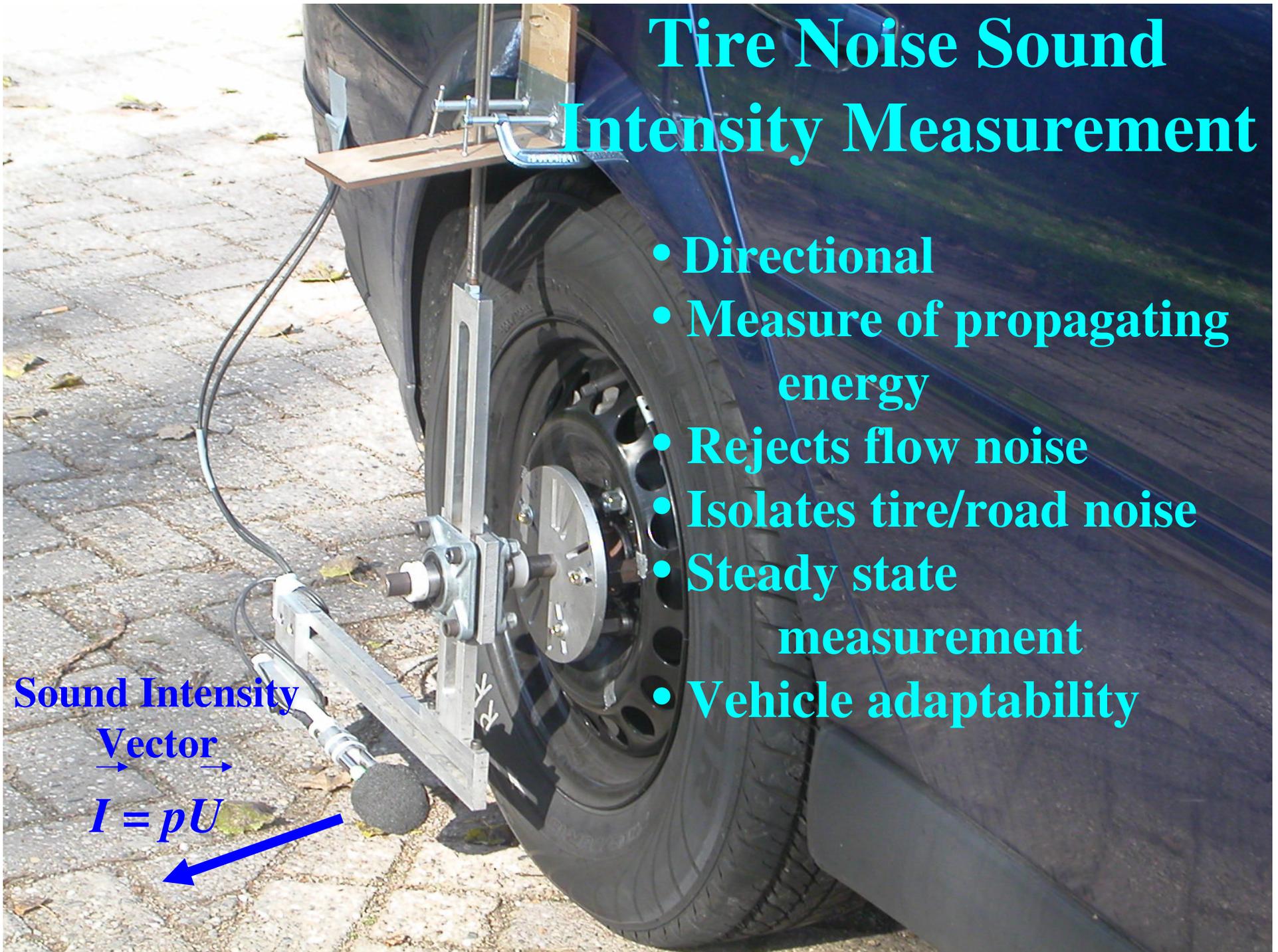
# Tire Noise Sound Intensity Measurement

- Directional
- Measure of propagating energy
- Rejects flow noise
- Isolates tire/road noise
- Steady state measurement
- Vehicle adaptability

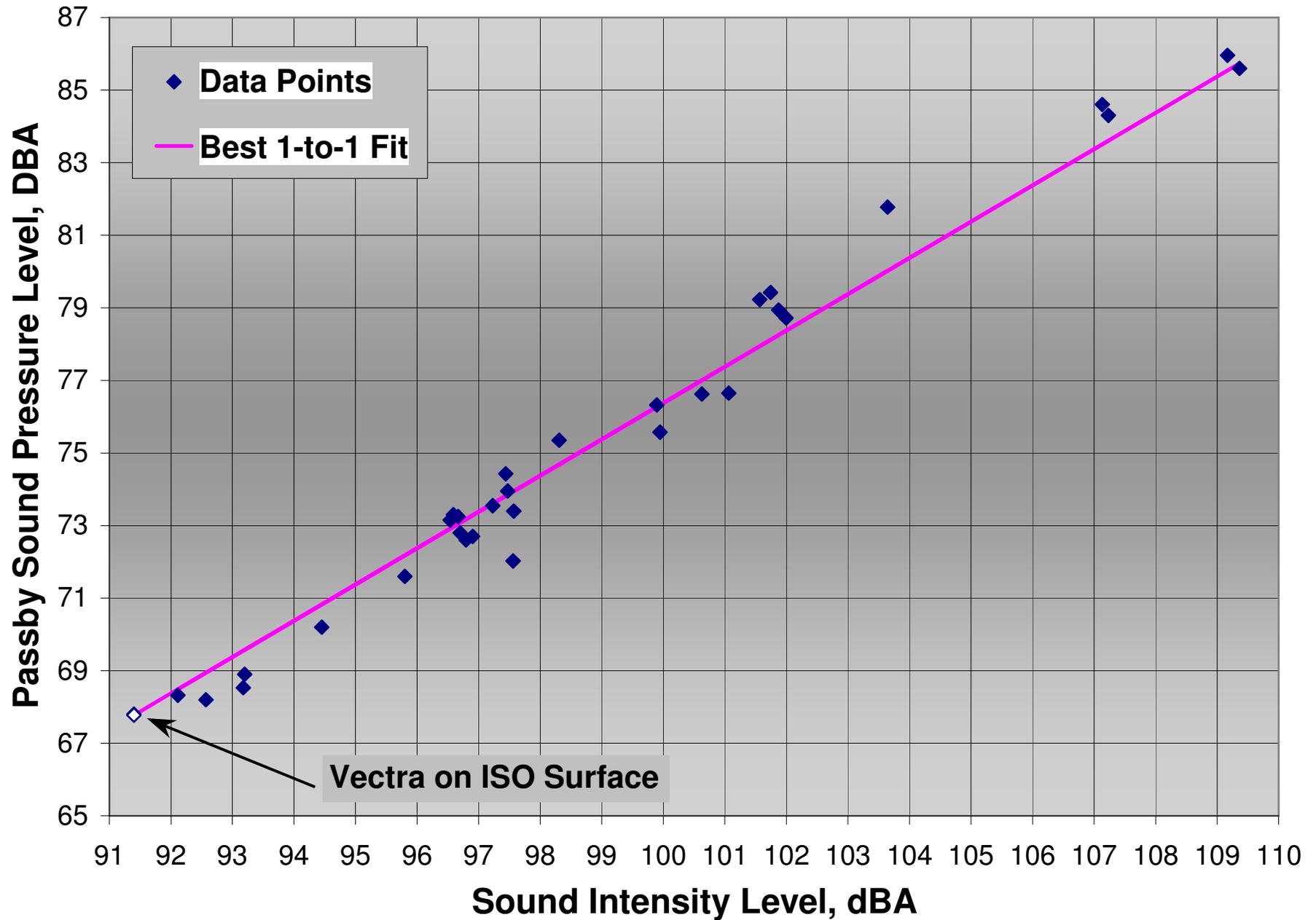
Sound Intensity

Vector

$$I = pU$$



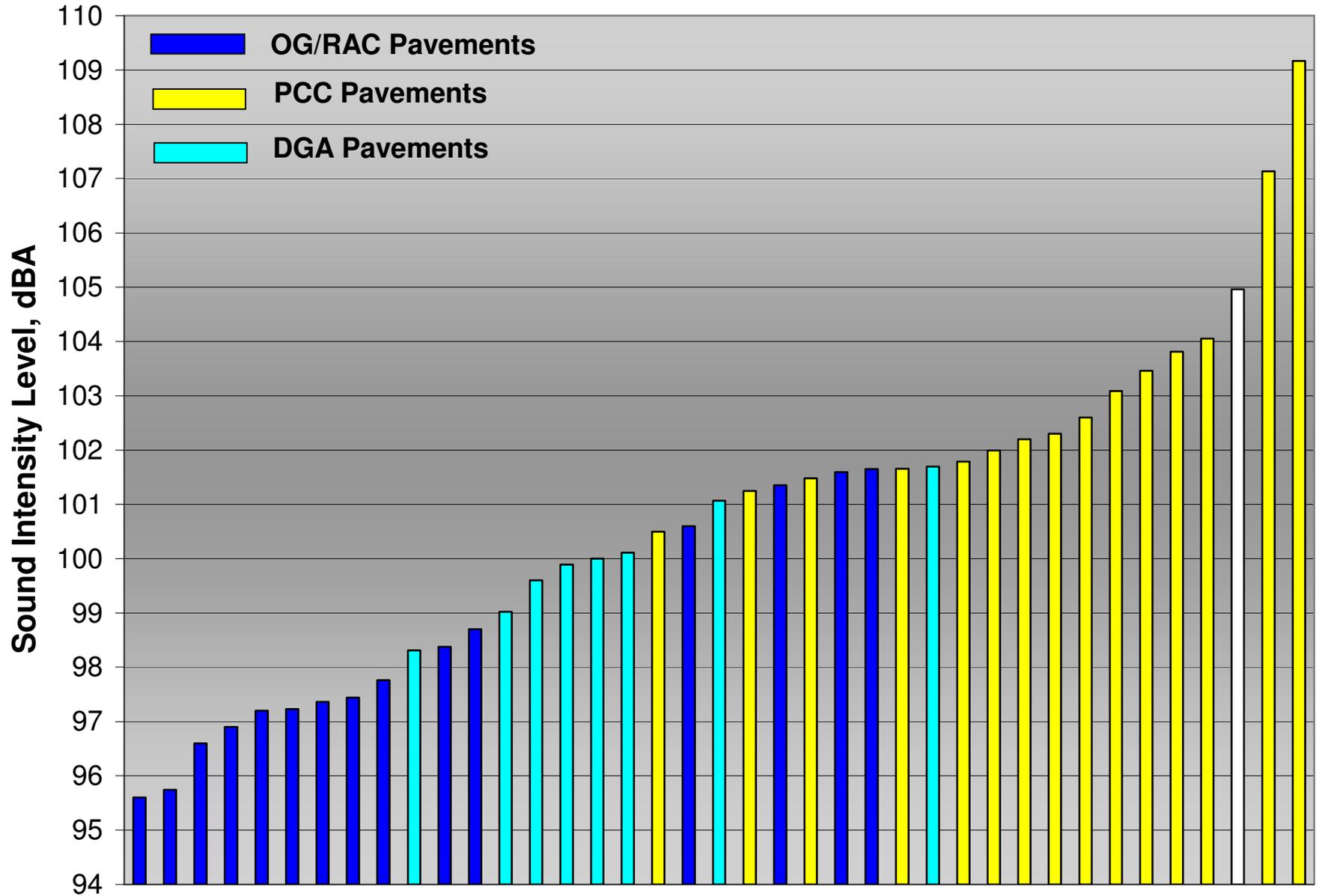
# SI to Passby Data with Opel Vectra



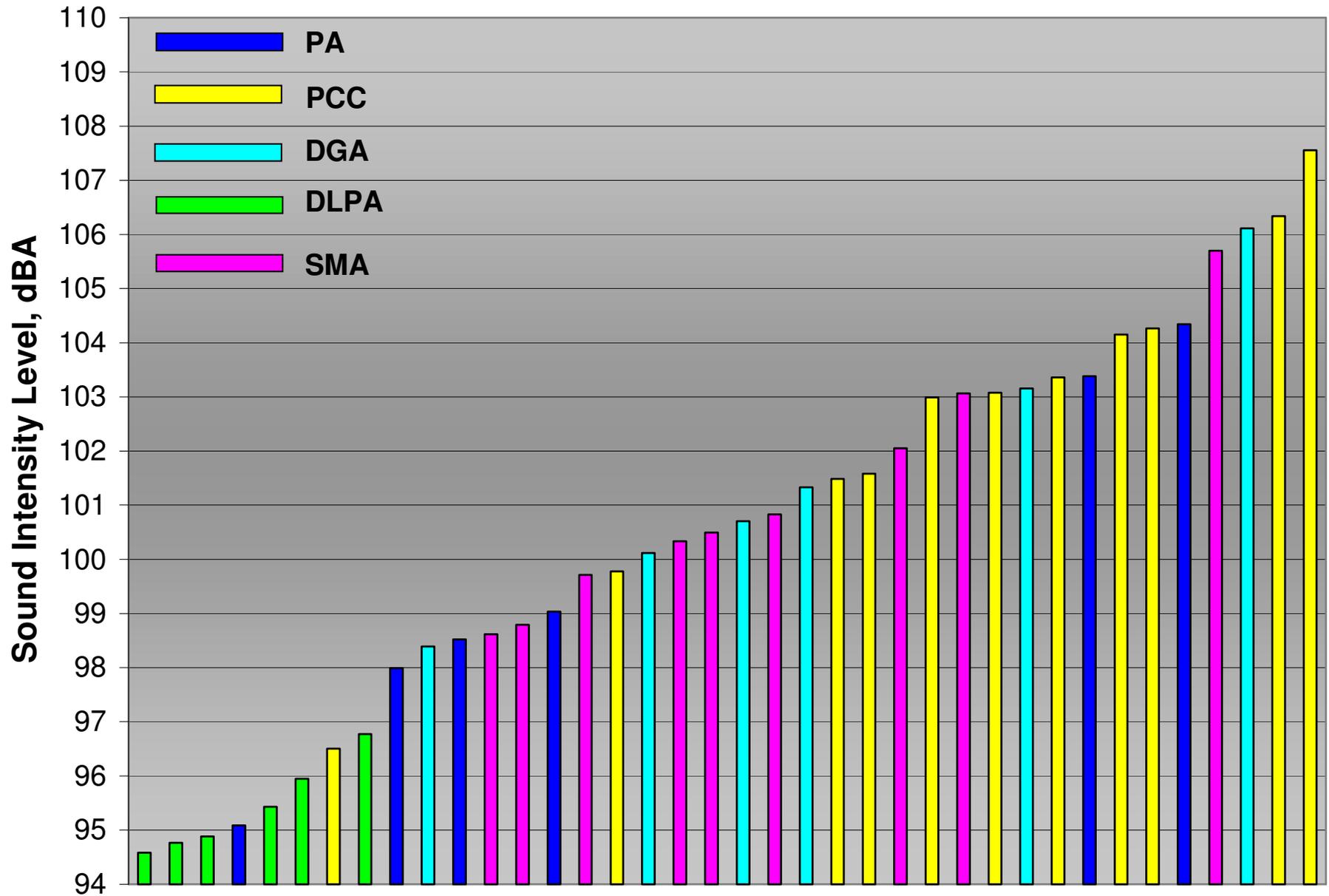
# Nomenclature

- PCC – Portland Cement Concrete
- DGA – Dense Graded Asphalt (non-porous)
- OGAC/RAC – Open Graded/Rubber Asphalt
- PA – Porous Asphalt
- DLPA – Double Layer Porous Asphalt
- SMA – Stone Mastic (Matrix) Asphalt

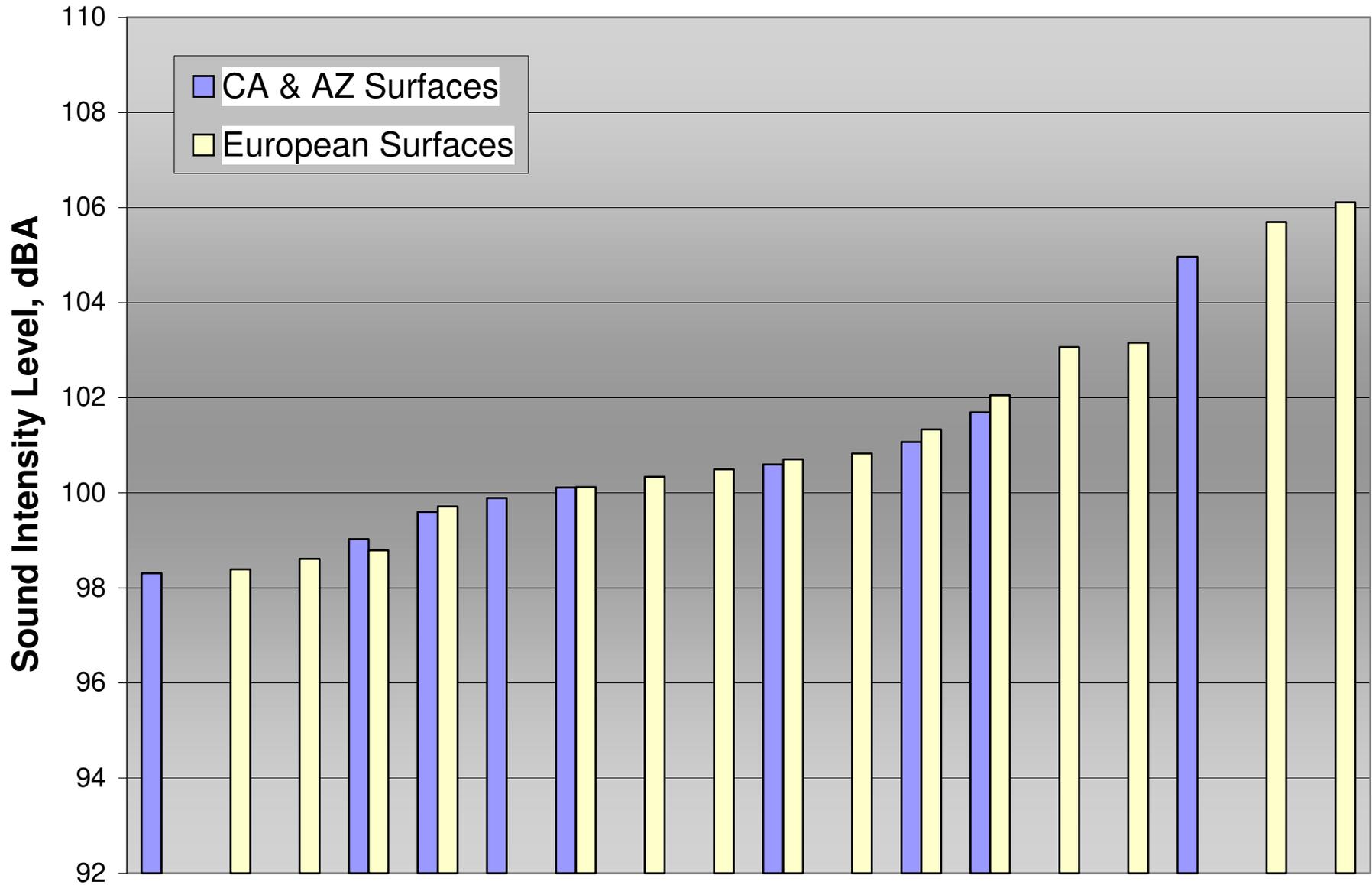
# Caltrans Data Base - California & Arizona



# European Pavements at 97 km/h



# DGA & SMA Surfaces



# Coarse & Fine SMA Surfaces



8/10mm – 105.7 dBA

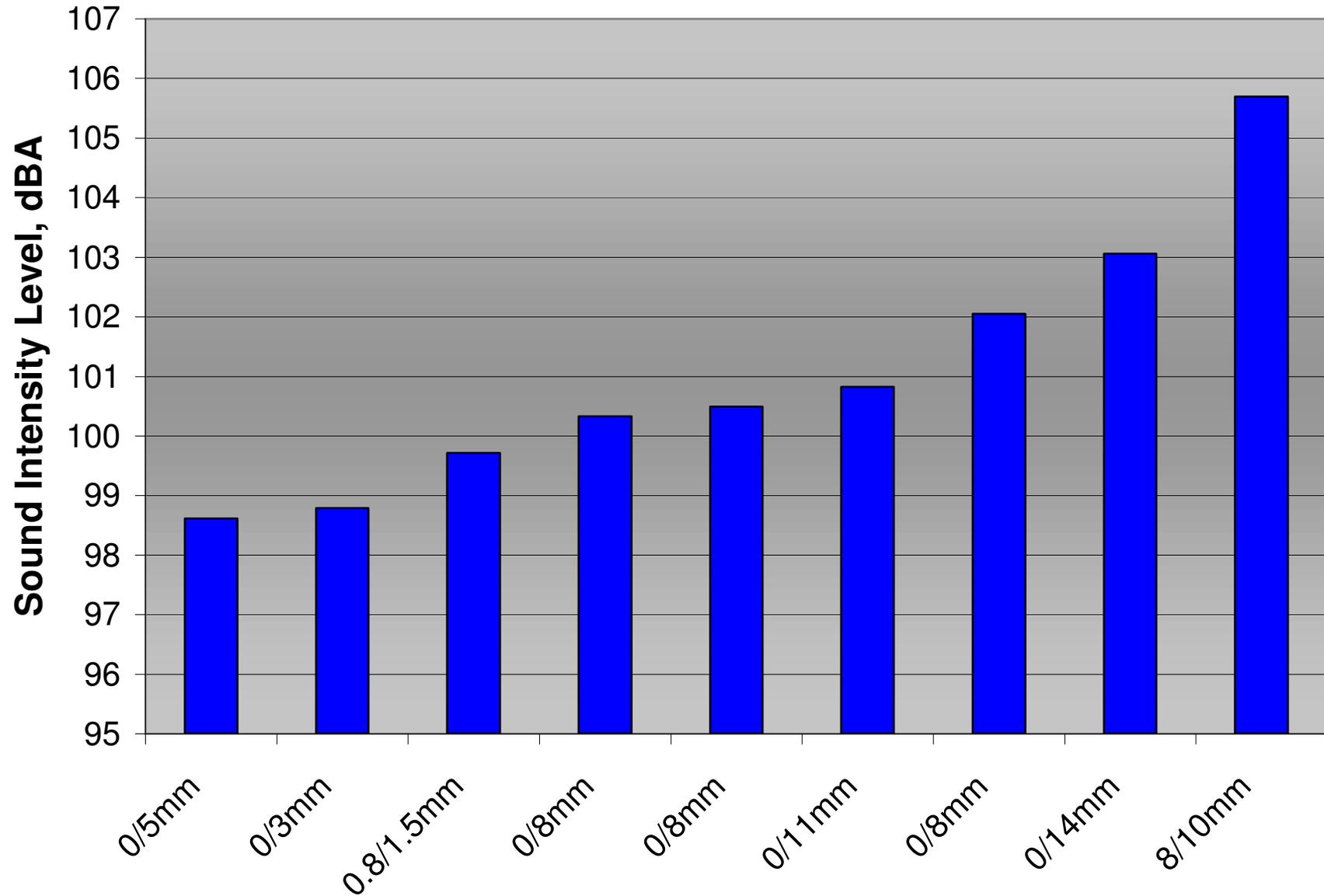
The image shows a coarse SMA surface composed of large, dark, angular aggregate particles. A silver coin is placed on the surface to provide a scale reference. The surface has a rough, textured appearance with significant void space between the particles.



0.8/1.5mm – 99.7 dBA

The image shows a fine SMA surface composed of small, dark, angular aggregate particles. A silver coin is placed on the surface to provide a scale reference. The surface has a much smoother and more uniform appearance compared to the coarse SMA surface.

# Stone Mastic Asphalt Surfaces of Varying Aggregate Size



# Coarse & Fine DGA Surfaces



0/10mm – 101.3 dBA

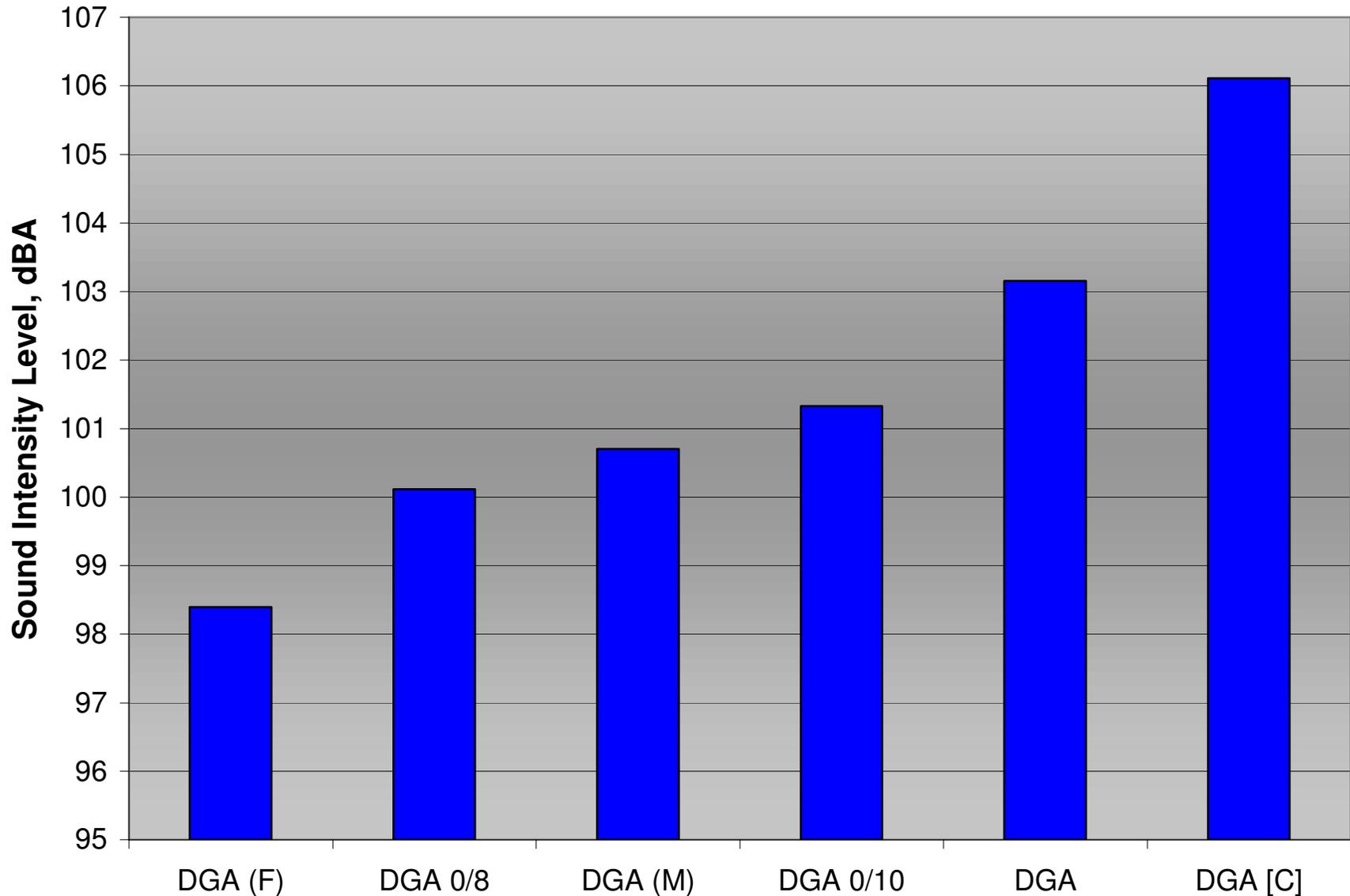
The image shows a close-up of a coarse aggregate surface. The aggregate consists of large, dark brown, angular particles of various sizes, with many being larger than 5mm. A silver coin is placed on the surface for scale, showing that the aggregate particles are significantly larger than the coin.



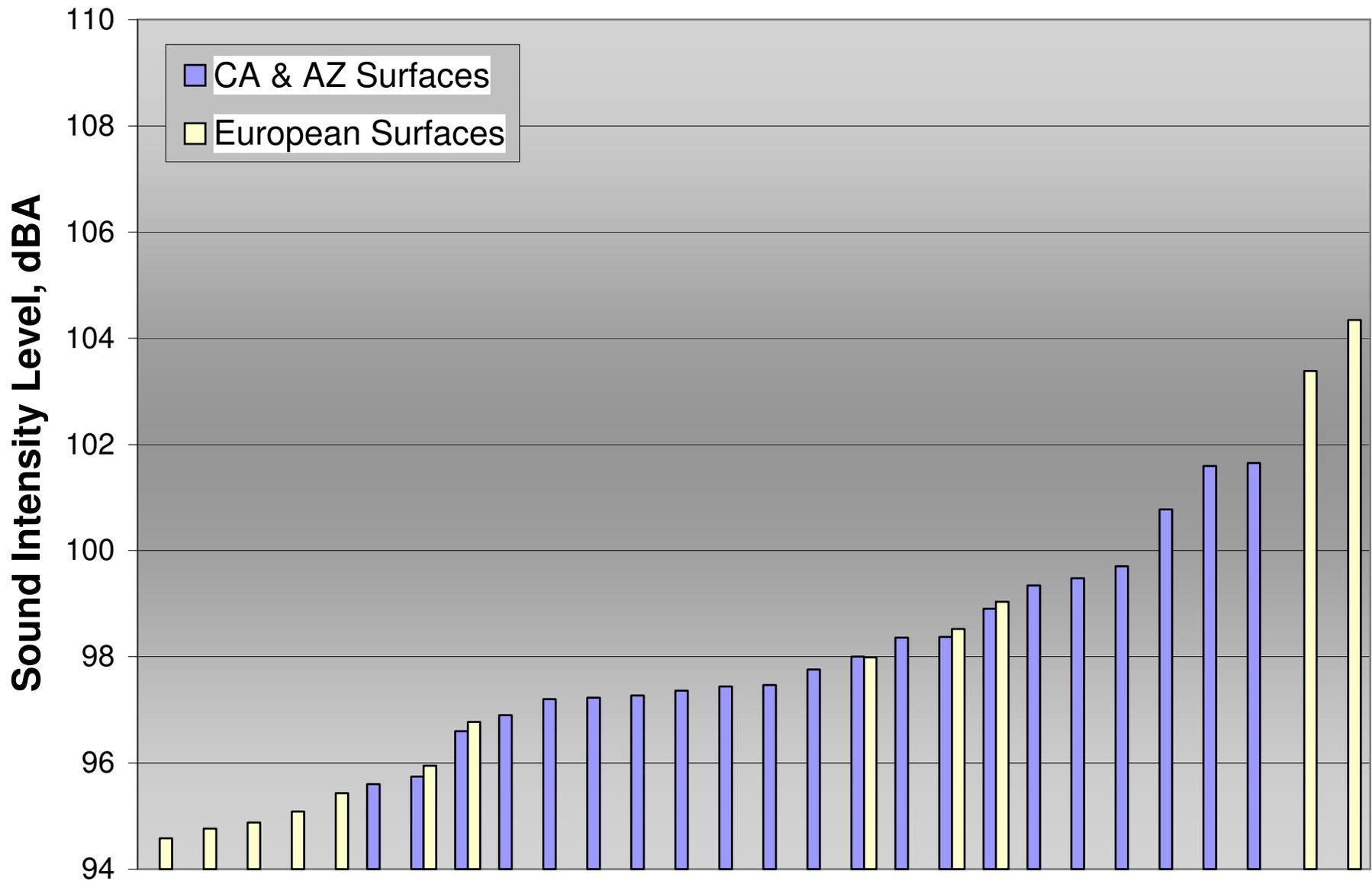
“Fine” – 98.4 dBA

The image shows a close-up of a fine aggregate surface. The aggregate consists of small, dark brown, angular particles, mostly smaller than 2.5mm. A silver coin is placed on the surface for scale, showing that the aggregate particles are much smaller than the coin.

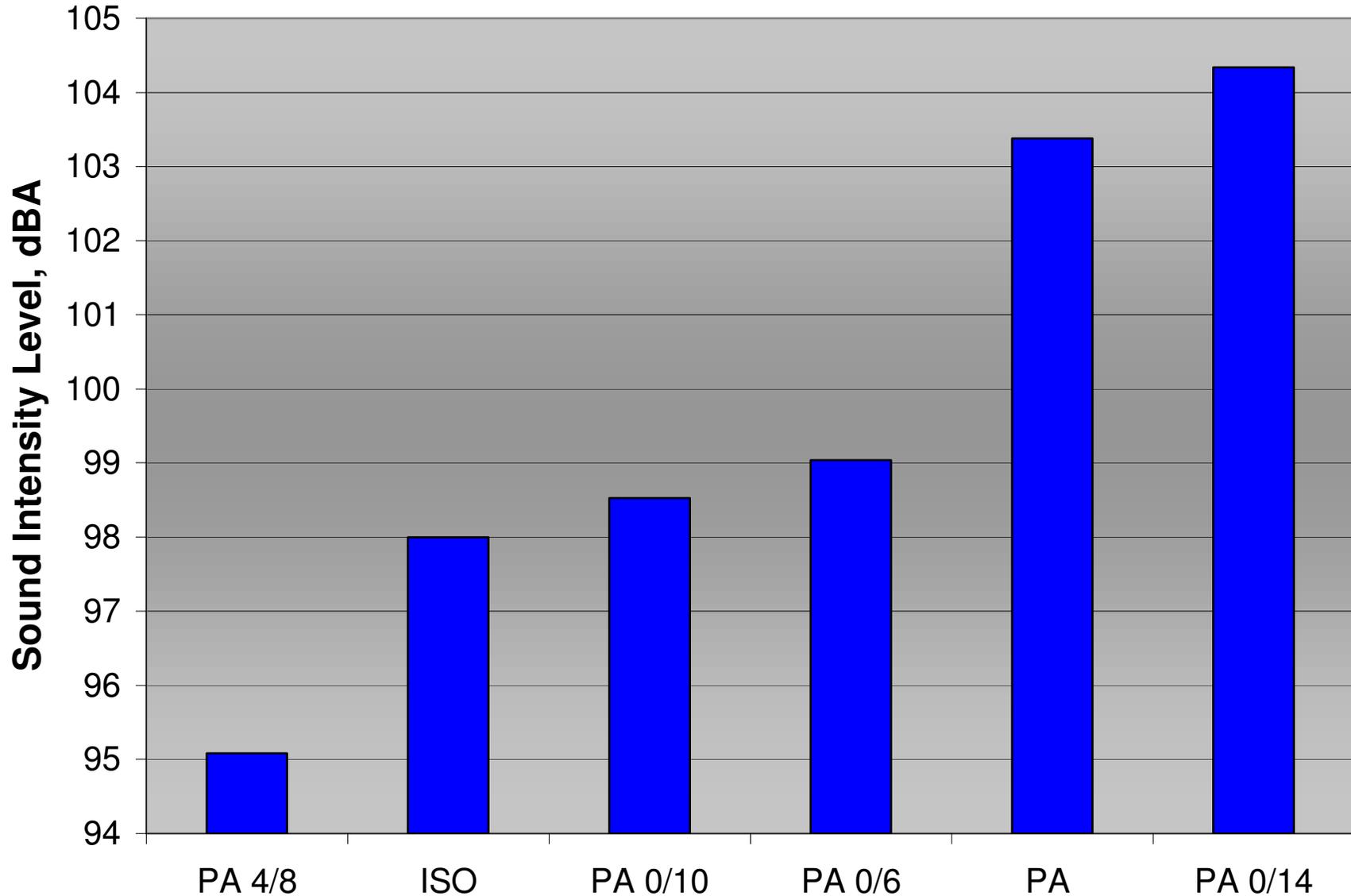
# Dense Graded AC Surfaces of Varying Aggregate Size



# Porous AC, OGAC, & RAC Surfaces



# Single Porous Layer Asphalt Surfaces of Varying Aggregate Size



# Coarse & Fine Porous AC Surfaces



**“Coarse” – 103.4 dBA**



**0/10mm – 98.5 dBA**

# Examples of “Porous” AC Surfaces



4/8mm – 95.1 dBA



ISO – 98.0 dBA

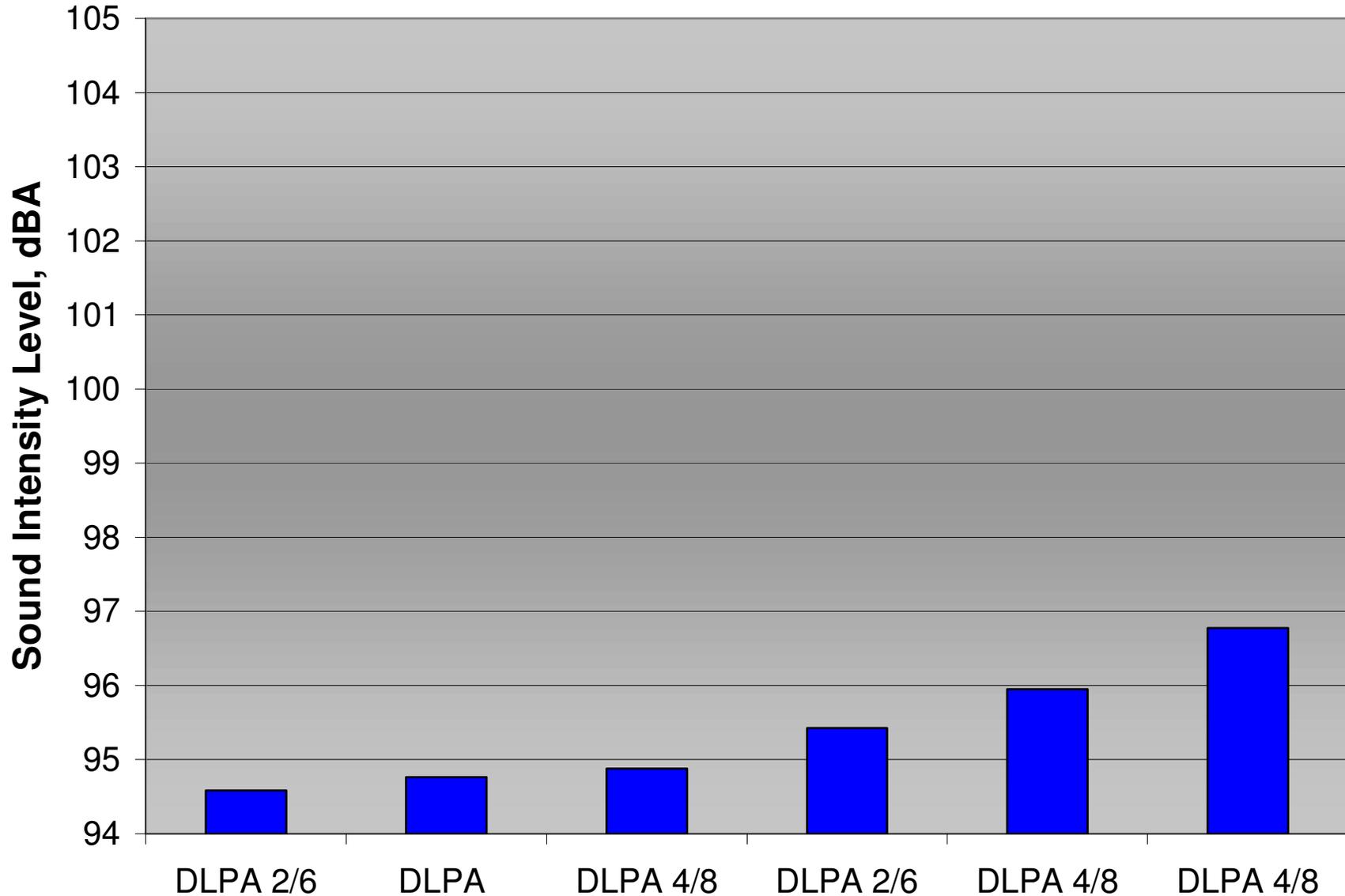
# Typical 2-Layer Porous Asphalt the Netherlands



**Small Aggregate Size**

**Coarse Aggregate Size**

# Double Porous Layer Asphalt Surfaces of Varying Aggregate Size



# Coarse & Fine Top Surfaces for Double Layer Porous AC

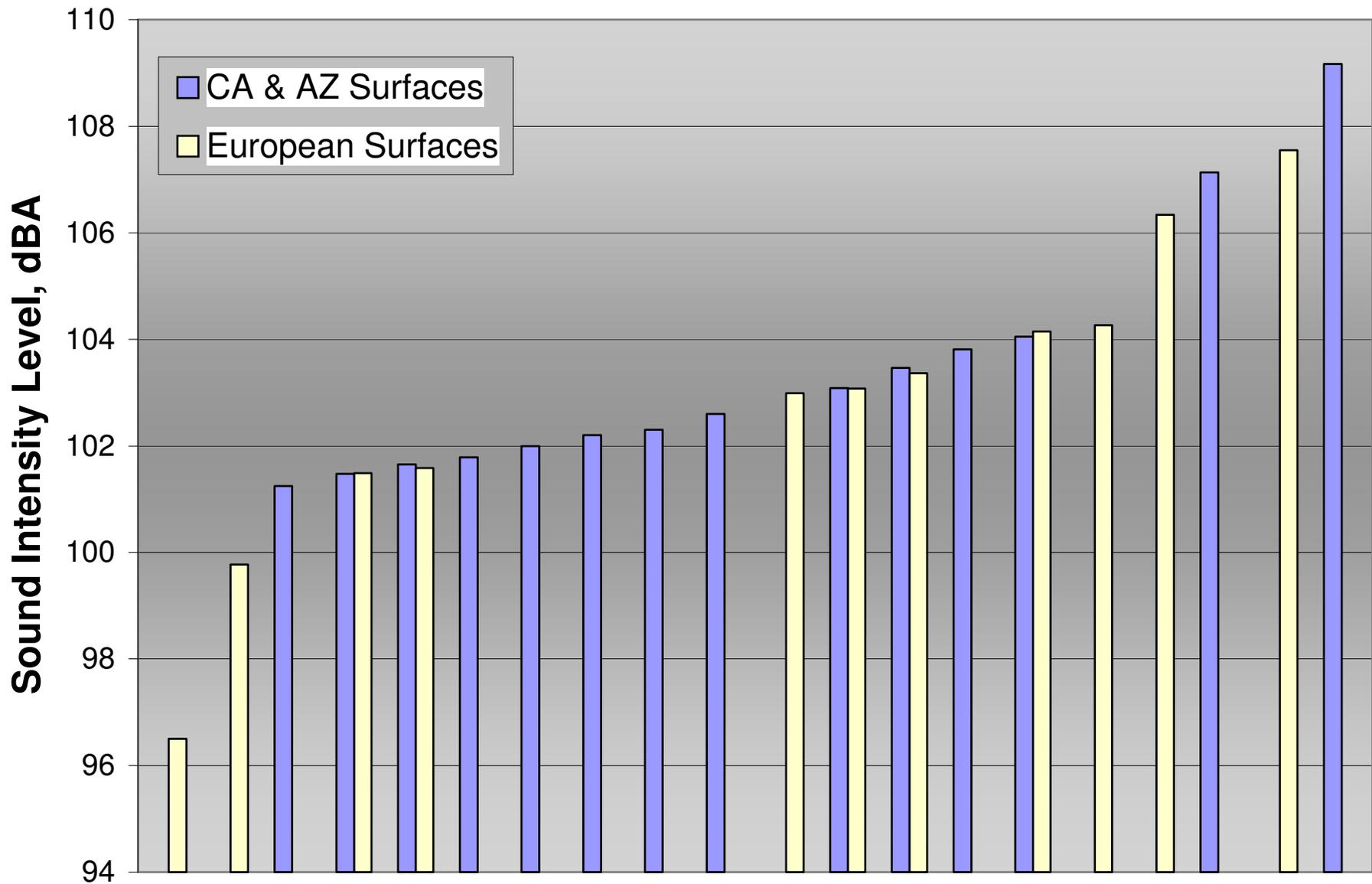


4/8mm – 96.6 dBA



2/6mm – 94.5 dBA

# PCC Surfaces



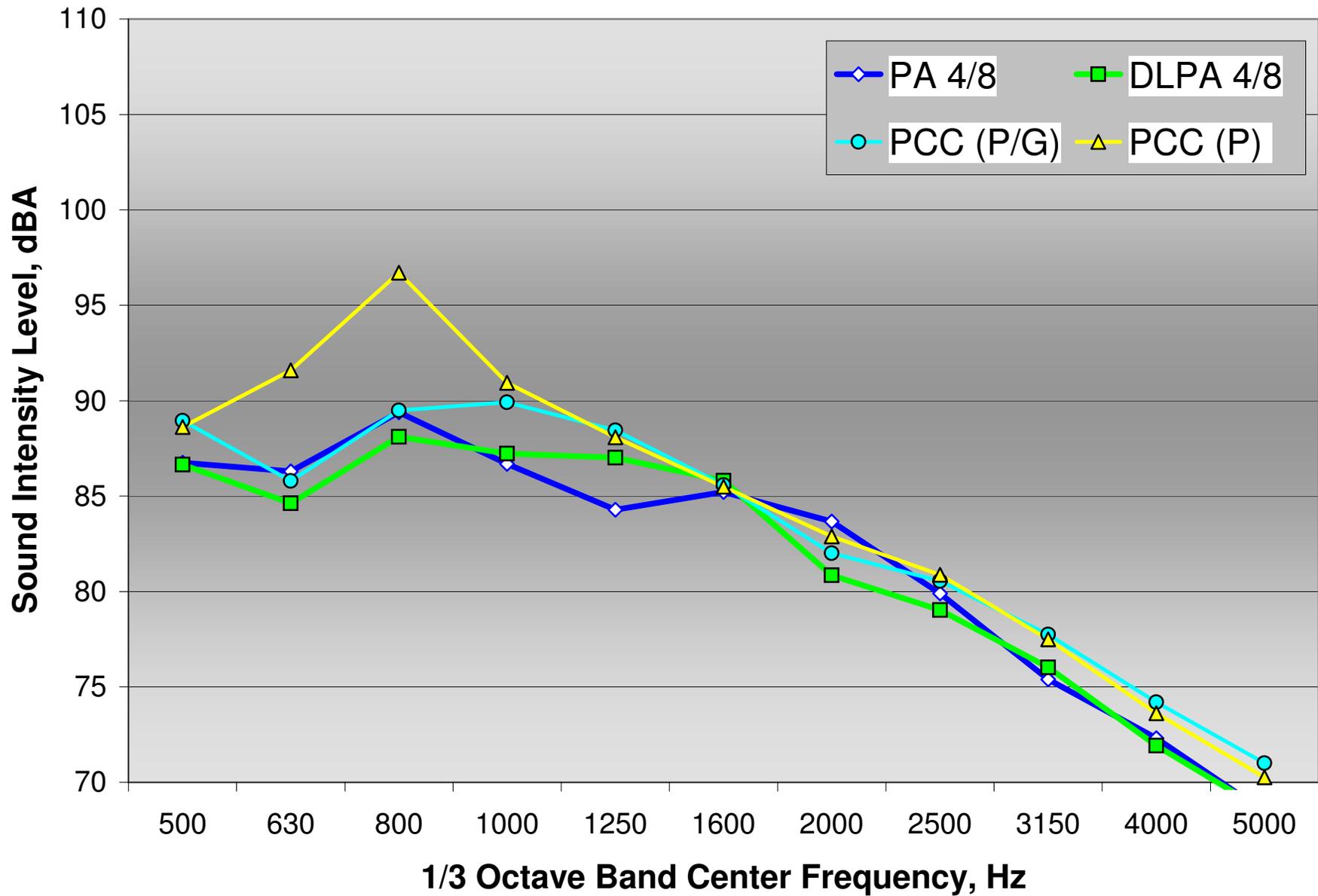
# Quiet Porous PCC Surfaces



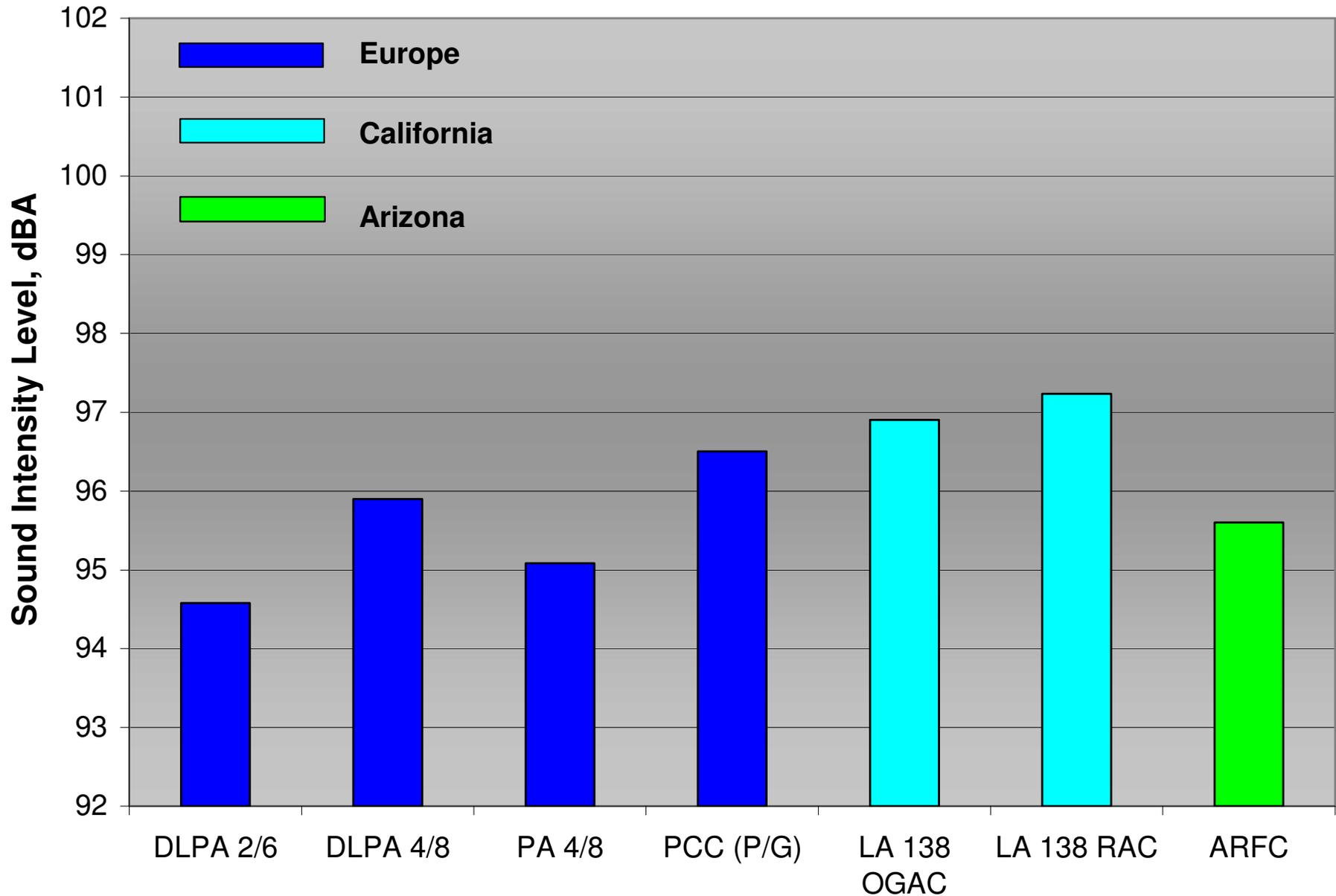
# Quiet Porous Surfaces



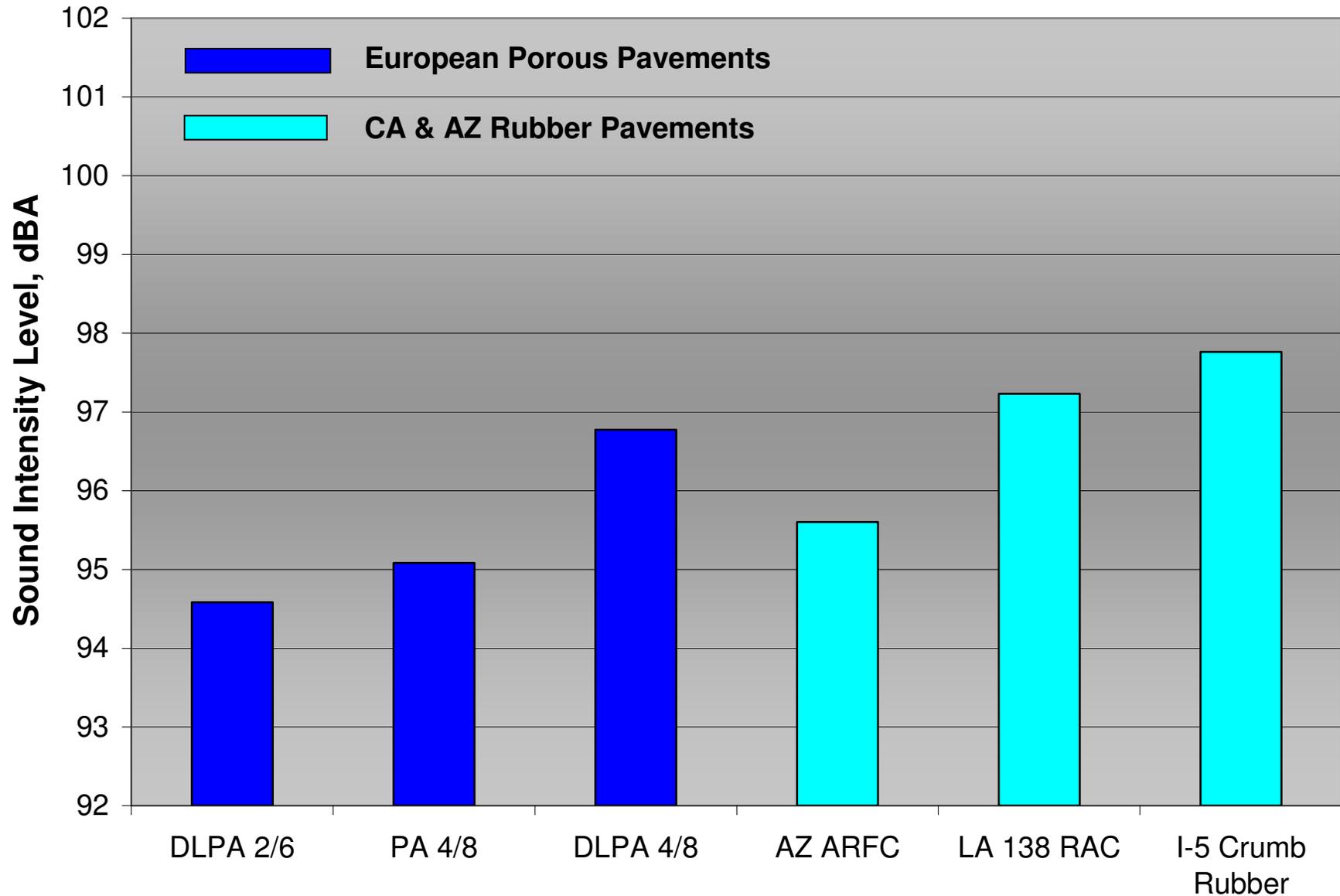
# Comparison of AC & PCC Porous Surfaces



# Comparison of Quietest Pavements

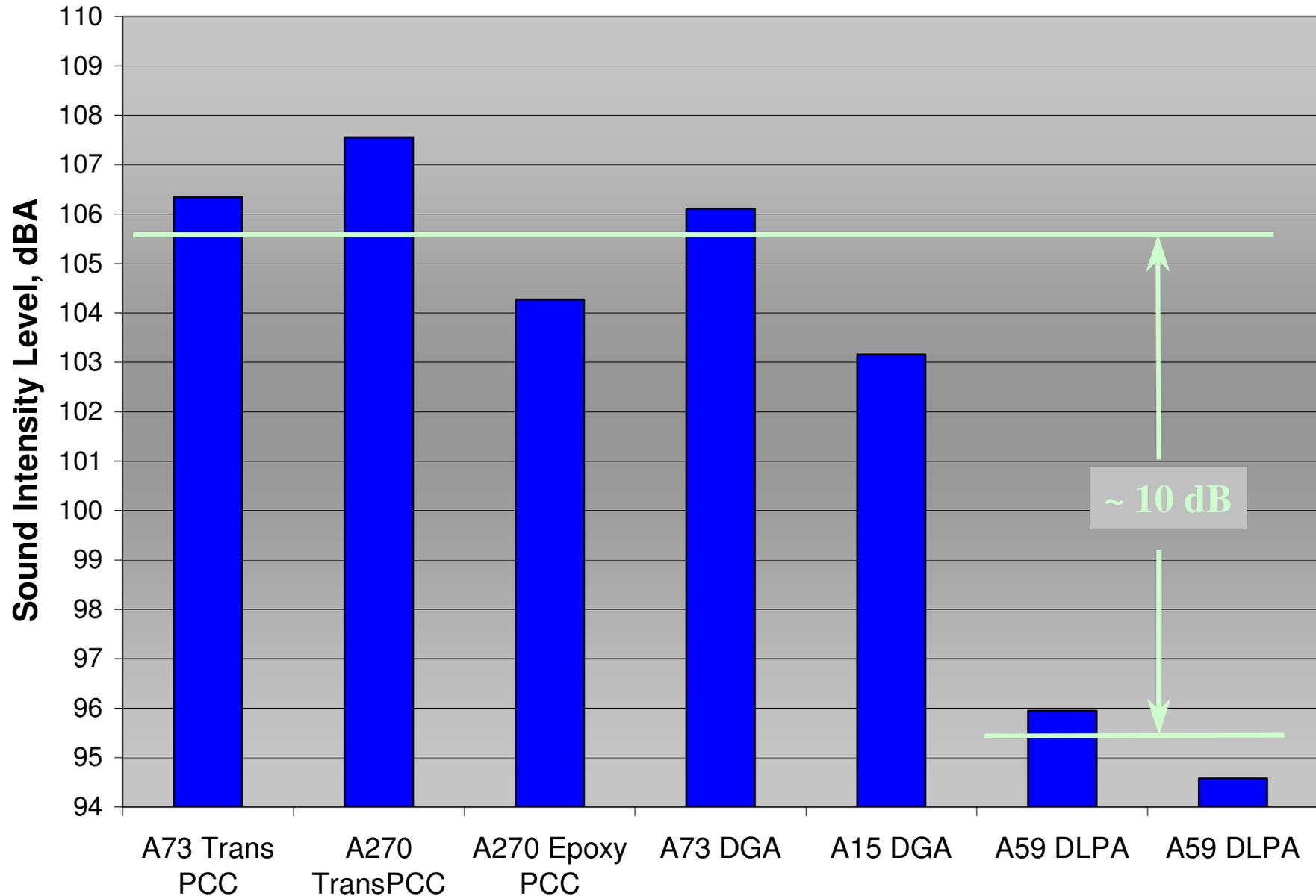


# Comparison of Highly Porous and Rubber Content Pavements



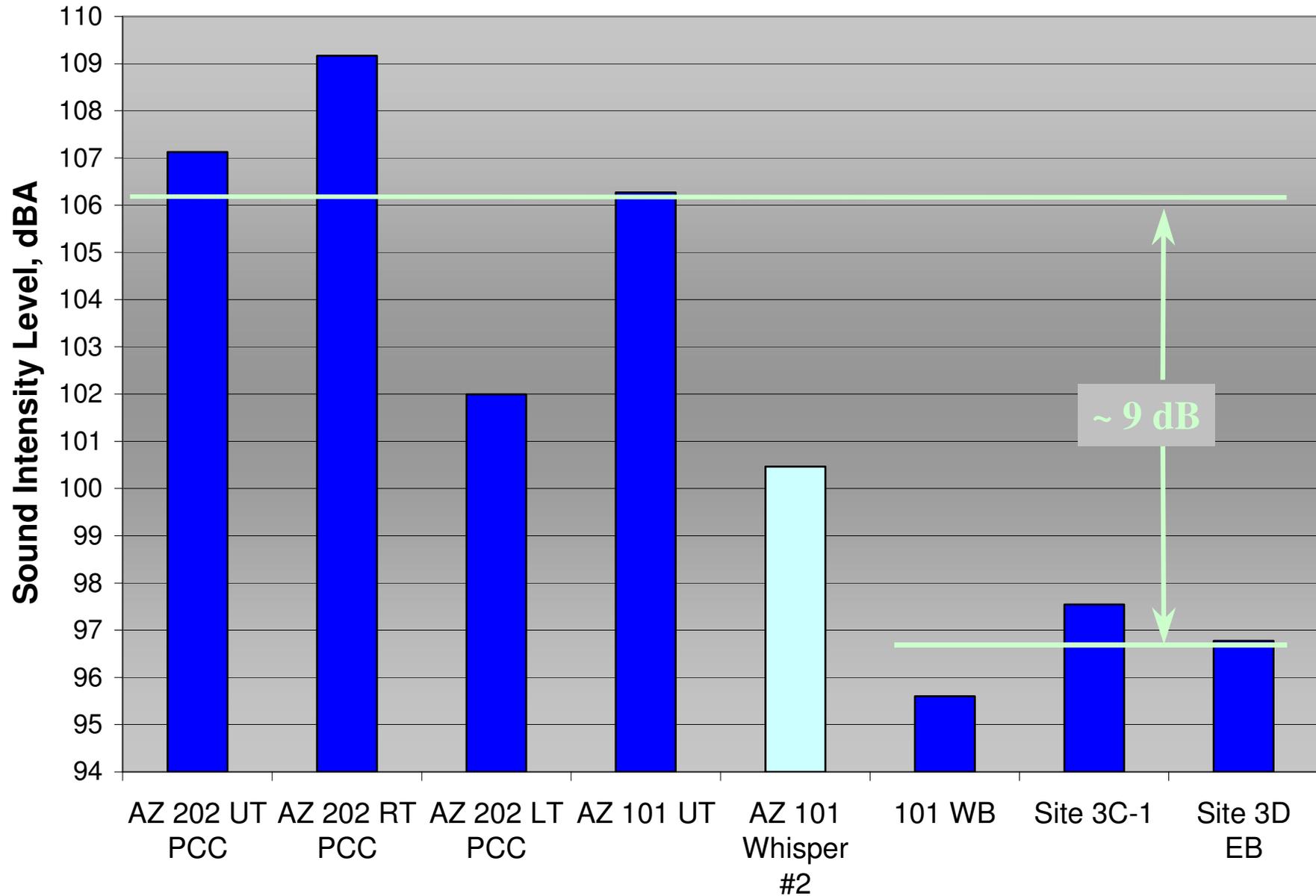
# Range of Typical & Quiet Pavements

## The Netherlands

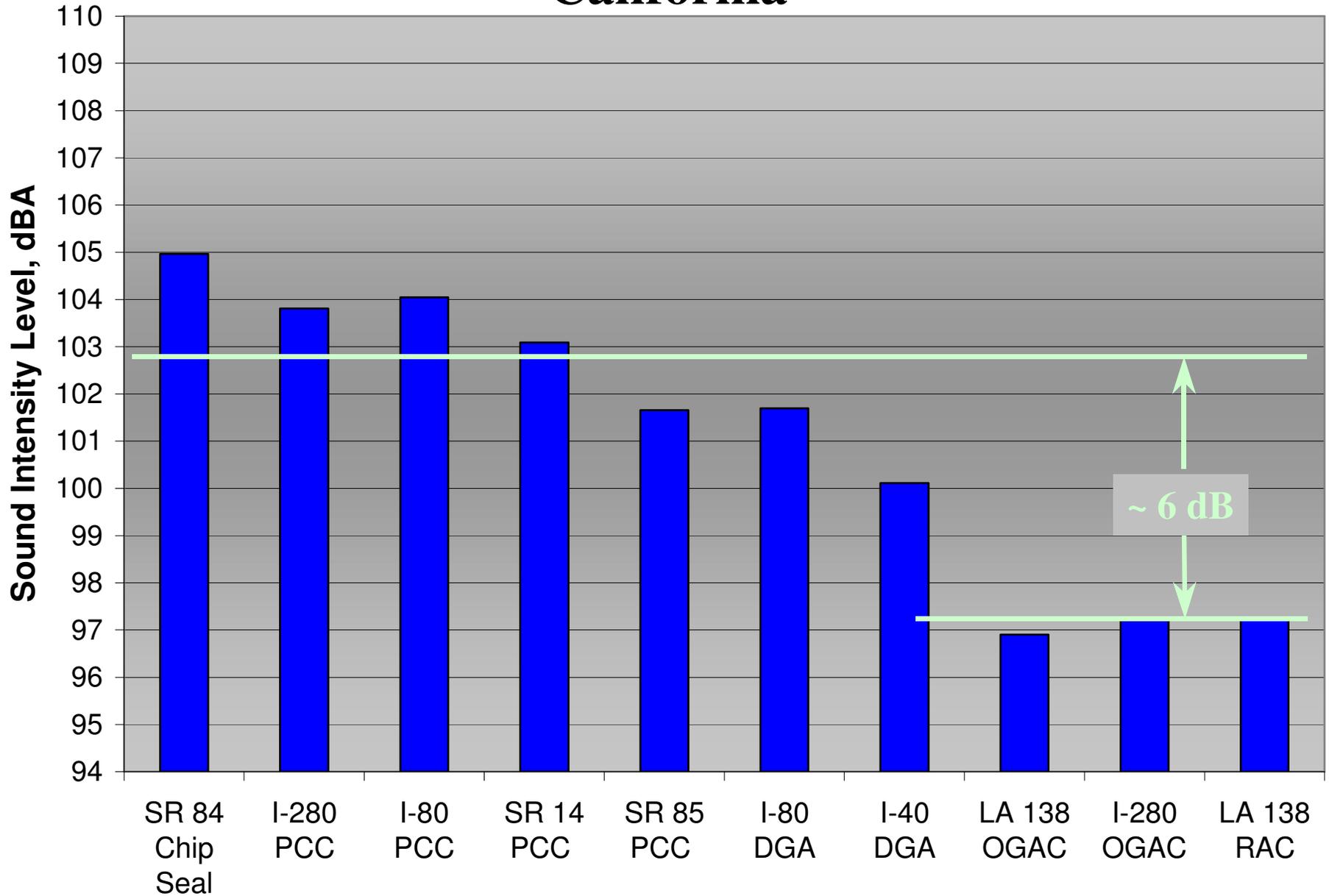


# Range of Typical & Quiet Pavements

## Arizona PCC & ARFC



# Range of Typical & Quiet Pavements California



# Knowledge Base to Date

**Confirmed  
by NITE**

- Pavement can reduce tire/pavement noise up to 8 to 10 dB depending existing and final conditions ✓
- Significant range in performance in each major pavement category – PCC, DGA, OGAC/RAC ✓
- As a group, open graded and/or rubberized AC's show the best noise performance in CA & AZ
- Apparent surface roughness/texture controls the lower frequencies ✓

# Knowledge Base

## **Lessons from the NITE Project**

- Highly porous, 2-layer AC construction can provide slightly better performance
- Porous PCC can produce noise performance comparable to other quiet pavements
- Exposed aggregate PCC's not found to be “quiet”
- SMA surfaces provide similar range of performance to DGA
- Constructions of the same specification can produce variation of up to 2 dB